A Ham Radio Makerspace

Build a workspace and the builders will come.

Dino Papas, KL0S

I have always enjoyed building my own ham radio equipment and found that sharing my excitement for the technical side of the hobby with other hams is a real treat. When my spouse, Toby, KL0SS, and I found our retirement spot here in Virginia, we were fortunate that our home's garage was a conditioned space. I knew it could provide a satisfactory year-round "Ham Radio Makerspace" for members of our local Williamsburg Area Amateur Radio Club (**www.k4rc.net**). After making a presentation on homebrewing at one of our club meetings, I found the discussion that followed generated enough interest among the members that I volunteered to host a club "Builders Group."

Contrary to popular belief, the essence and spirit of ham radio experimenting and homebrewing remains alive and well today, evidenced by both simple and complex technical project articles in *QST* and *QEX*, on countless ham-related electronics engineering blogs and YouTube videos, and discussions on numerous low-power builder blogs and e-mail reflectors. Additionally, there is a growing interest in the use of microcontrollers — such as the Arduino and Raspberry Pi — in both radio and ham shack accessory projects.

Building a Novice license class, vacuum tube CW transmitter from scratch using salvaged TV parts is no longer the gateway to ham radio that it once was. Although the style of homebrewing and kit building has changed over the years, many hams continue these pursuits and enjoy the technical side of the hobby. But this new ham generation often lacks the Elmer, or mentor, that many of us had back in the day. It can be tough getting started on a project without ever having seen something like it done before (think about your first PL-259).

From Elmer to Maker

Most hams who have been at it for a while started out building projects under the tutelage of more experienced operators who may have been a family member, friend, neighbor, or a member of a local ham club. My dad George Papas, WN6IFX (SK), was a former Greek Merchant Marine radio operator who helped me learn Morse code.

I was also fortunate to have a high school electronics teacher, Truman Whorton, WB6QFV (SK), who, along with our school's Amateur Radio club, provided my entry to the hobby. Those first homebrew projects were built under their watchful eyes at home and in the school's electronics and metalworking shops.

So where do new hams go now to get that same kind of start? As people both young and old are much busier today, it can be difficult for them to allocate precious time for their own hobby pursuits, especially if they lack the confidence that they will be successful. But the recent explosion of the "Maker" community has in many ways reinvigorated their ham builder counterparts and has sparked a resurgence in returning to the role of curious experimenter and builder, a hallmark of early hams. Surprisingly, some pundits have actually taken offense at being called a "Ham Maker" as opposed to a "homebrewer" or "builder." Personally, it makes no difference to me what you call yourself as long as you're building something related to ham radio — if your soldering iron is hot, you're okay in my book!

Getting Started

The first thing I did to get the Builders Group started was to send a note to our club's e-mail reflector. I asked folks if they would like to participate and requested information about their experience level.

Builders Group Mentor Chris Courson, KC4CMR (standing), helps group members with their projects.

I also inquired about meetings; what would be the best day of the week, time, and meeting frequency. Finally, I asked if they would like to take on a group project or work on their own individual projects. After collecting, collating, and analyzing this information I thought the group might be about 12 – 15 members in size, that bi-weekly Saturday morning sessions worked best for all involved, and that folks wanted to start out by selecting their own projects. I asked friends Chuck White, AI4WU, and Chris Courson, KC4CMR — both of whom have strong technical backgrounds — to act as mentors for the building sessions. Also, before our first get-together, I asked them to check my plan and the proposed workspace layout.

Builders Group member Gray Reid, W4NGR, takes advantage of the author's workbench.

Logistics

Our builders would need tables, chairs, power, additional task lighting for their work area, and some basic supplies, in case they forgot to bring something along in their toolkit (solder, basic hand tools, etc). We set up folding tables, chairs, and floor extension cord protectors, as well as additional magnifying and table lamps. At one of our local "feed and seed" stores, I found two very heavy, hard rubber mats normally used to cover the floor in horse stalls. These were used to provide a buffer between the tables and chairs and the concrete floor. A supply of egg cartons was also gathered for builders to use in organizing their project parts, and finally, a coffee maker and doughnuts rounded out the necessary supplies.

During our first session, we found that Internet access was a useful thing to have, as several questions arose about projects, most often relating to a component data sheet, or for information or instructions for a product or kit. I established an open, temporary access portal to the Internet through our home's Wi-Fi router. This connection did not require a password, and it allowed the builders to reach the web from their own tablets or smartphones.

We also made a printer available in the event someone needed a hard copy to use at the table. Finally, I made my own shack workbench available to any of the builders who needed to do more advanced construction or access more sophisticated test equipment than they may have brought along.

Safety

Both my spouse and I are retired soldiers, and as safety was always a paramount concern during military operations, I wanted to make sure the workspace was as hazard-free as possible. My biggest concern was for eye safety, either from snipped component leads being flung through the air or solder splashes. So a quick discussion of safety was included at the beginning of each session and eye protection was a requirement in the form of either a builder's own prescription eyeglasses or standard safety glasses. A sink for hand washing, a fire extinguisher, and a first aid kit were also available.

We began each session with introductions and members giving an overview of the project they were working on, their progress to date, and any problems they may have encountered since the last get-together. A club member filmed and posted a short video of one of our sessions so we could share the fun with the rest of our club. You can see the video at **vimeo.com/62749437**.

Projects

Club builders brought a variety of projects to work on and share with the group. These included low-power transceivers, boat anchor radios, digital displays, frequency counters, test equipment, emergency power battery chargers, and some commercial equipment that simply needed a little TLC. Our mentors circulated among the builders providing guidance, while realizing when to let a new builder experience a bit of "discovery learning" by sometimes making a mistake. As an Army service school and ham radio licensing class instructor, it was always satisfying for me to see the light come on in a student's eyes for the very first time. When one of our builders accomplished tasks they may never have done before, that same satisfying feeling came along when their project was complete and they were proud to display their new piece of working equipment.

The Future

The group concluded its most recent multi-week session in November 2014, and plans are being made to continue the gatherings in the spring and fall of 2015. I'm sure projects revolving around microcontrollers will become more popular but, surprisingly, there remains a trend among the group to work on older equipment as well. If your club doesn't have a builders group, please consider starting one; the excitement and personal satisfaction you'll experience will make your effort worthwhile. I want to acknowledge the valuable early-on input of long-distance friend Mike Doty, W0MNE, for sharing his experiences with his own builders group.

All photos by Dino Papas, KL0S.

Dino Papas, KL0S, Colonel US Army, Retired and ARRL® Life Member, has been a ham for over 45 years. He holds a BSEE degree from the University of California at Davis and a Masters of Engineering Administration degree from The George Washington University. For 26 years he served on active duty as an infantryman with ham radio, shortwave listening, computers, and electronics as his top hobbies. He also shares his excitement for the technical side of ham radio by penning a series of *KL0S Shack Notes* that are distributed among Williamsburg Area ARC members and friends around the country.

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Makerspaces

The makerspace movement provides access to advanced tools and equipment, as well as expert Elmers to help your project along.

Sooner or later, most serious microwavers find a need for tools that go beyond the household toolbox. Not many of us have a vertical milling machine or a lathe, but they can be handy in creating that special dish feed, trying out a new idea for mounting equipment, or just assembling the gear into a neat, packaged system. Even if we had the machinery, most of us aren't expert machinists.

I received an e-mail from a ham who wanted to build more microwave gear but, because he lives in an apartment, didn't have many tools. I belong to a local makerspace with machine tools much bigger and better than my own shop, and I suggested he might join one. A quick online search found three makerspaces near him — the next day, he reported that he had joined one.

A makerspace is typically a collaborative workshop where people can invent and build whatever suits their fancy, taking advantage of shared tools, resources, and mentors (which hams call "Elmers"), to have fun and learn new skills. It can also serve as an incubator where folks with an idea for a new product or business can get a start.

My introduction to makerspaces was a talk at a meeting of the North East Weak Signal Group, about the Tech Valley Center of

Meeting Your Maker

Makerspaces, also known as hackerspaces or fablabs, go beyond the typical home workshop. Makerspaces offer their members access to professional-type equipment that would be impractical for the home workshop. For example, one Connecticut makerspace has a LulzBot Mini 3D printer, a 4 × 8 foot CNC wood router, CNC engraver, Bridgeport milling machine, both large and small lathes, and other large machine-shop tools. For the more electronically-minded, an Electronics Workbench and Arduino workstation are also available.

Beyond equipment, makerspaces also provide an interactive environment where individual members support each other over their project's rough spots.

Makerspaces can be found by searching on "makerspace" + your state. An unorganized list of makerspaces can be found at **spaces.makerspace.com/makerspace-directory**. Use your browser's FIND feature to locate makerspaces in your state. — *Steve Sant Andrea, AG1YK*

Figure 1 — Experimental 24 GHz feed horns I machined on a lathe at The Foundry makerspace. [Paul Wade, W1GHZ, photo]

Figure 2 — Waveguide switch for 24 GHz being machined on a CNC milling machine. [Paul Wade, W1GHZ, photo]

Figure 3 — The "Not Your Grandpa's Ham Radio" exhibit at the 2015 San Diego Maker Faire. [Paul Williamson, KB5MU, photo]

Figure 5 — Kerry Banke, N6IZW, and Drew Arnett, KB9FKO, offering a 10 GHz foxhunt receiver to Maker Faire attendees. [Paul Williamson, KB5MU, photo]

Gravity (**www.tvcog.net**), a makerspace in Troy, New York. The talk was given by Bob Bownes, KI2L, one of the co-founders.

Pursuing the concept, I happened upon The Foundry (**thefoundryvt.org**), a makerspace starting up near me, and joined the group. Then a machine tool company closed their local plant and donated a large number of machine tools to the career center at a local school. Our group helped to set up the machinery in a shared space, which earned us access on nights and weekends.

I have been taking advantage of the machinery at the makerspace to build some microwave equipment. Figure 1 shows a series of experimental 24 GHz feed horns that I made on a lathe. I am now learning about CNC (Computer Numerically Controlled) machining from members who have expertise. CNC is often used for automated mass production, but can also perform operations that are nearly impossible with human operators, like the curved slots in the waveguide switch being machined in Figure 2 — you can see the chips flying!

Other makerspaces have different capabilities, not just machinery. Some have 3D printers or laser cutters, woodworking equipment, electronics, or welding facilities. Some specialize in robotics or Arduino stuff. Much of this is new for many people who have no background in DIY — even soldering is exotic for many.

Ham Radio Applications

An article in the February 2015 issue of *QST* described "A Ham Radio Makerspace," where hams get together to work on homebrew projects.[1] The shared resources of equipment and expertise helped hams who may not have the skills, or test equipment of their own.

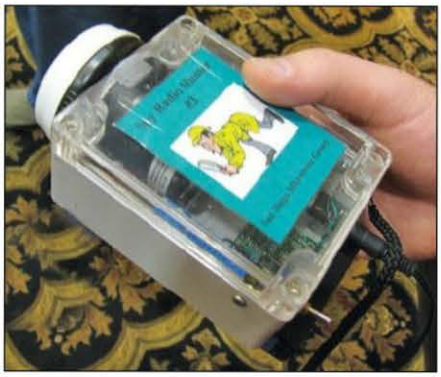

Figure 4 — At the Maker Faire, kids were invited to try a foxhunt using this simple 10 GHz receiver. [Paul Williamson, KB5MU, photo]

What about makers who are not hams? I've noticed that everyone at the makerspace wants to make something, but some don't know what to make. Some folks seem curious about what I am working on, and I drop hints, but haven't hooked anyone — yet. The Foundry was pleased to be asked to make a new ball for the local First Night celebration on New Year's Eve — a group effort produced a ball not quite as big as the one at Times Square. You can see it on their web page.

At Microwave Update 2015 in San Diego, there were two presentations on using microwaves to attract makers to ham radio. Dennis Kidder, W6DQ, and Wayne Yoshida, KH6WZ, from the San Bernardino Microwave Society (**ham-radio.com/sbms/**), did a demonstration titled "Not Your Grandpa's Ham Radio" at the 2015 San Diego Maker Faire, which had over 15,000 visitors. Figure 3 shows the booth, with information on the newer aspects of ham radio like software defined radio (SDR), Automatic Packet Reporting System (APRS), broadband hamnet (BBHN), Amateur Radio Emergency Data Network (AREDN), and of course, microwaves.

The second presentation, by Kerry Banke, N6IZW, and Drew Arnett, KB9FKO, from the San Diego Microwave Group, made simple, inexpensive 10 GHz receivers for transmitter hunting in the Maker Faire convention hall. The transmitter was an inexpensive intrusion alarm module, keyed by an Arduino. The receivers, shown in Figure 4, were labeled "Spy Radio Hunter," and kids were able to take them and get an interactive taste of ham radio — apparently it was a hit. Figure 5 shows Kerry and Drew handing out the receivers.

Opportunity

The combination of makerspaces and ham radio has many possibilities. For microwavers, having access to equipment and resources could enable some new ideas and improved gear. For the non-hams, an exposure to ham radio might channel the desire to build something in new directions — a chance to attract motivated younger men and women to the hobby. Everyone can have fun building something. If there is a makerspace near you, check it out.

[1] D. Papas, KL0S, "A Ham Radio Makerspace," *QST*, Feb 2015, pp 78 – 79.